

THE

CATECHISM OF NATURE;

FOR THE USE OF

CHILDREN.

By DOCTOR MARTINET,

PROFESSOR OF PHILOSOPHY AT ZUTPHEN.

TRANSLATED FROM THE DUTCH,

By JOHN HALL,

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ROTTERDAM.

"READ NATURE; NATURE IS A FRIEND TO TRUTH."

YOUNG.

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ADVERTISEMENT.

THE alterations, which have been made in this little work, with the omission of some questions, and the addition of others, were judged necessary to procure it a more general reception, and to make it more extensively useful. If this meets with the public favour, it is the Translator's intention to undertake the Professor's larger work, which bears the same title as the smaller one. 'Katechismus der Natuur,' in four volumes in octavo. It has gone through five editions, and is designed for persons of riper years.

J. H.

Rotterdam.
Mar. 1, 1790.

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Prof. Dr. H. H. H.
Mar. 1, 1870.

T H E

CATECHISM OF NATURE.

INTRODUCTORY DIALOGUE.

TUTOR.

THE first grand object of your enquiry, my dear pupil, is, God your Creator.

PUPIL.

How may I acquire a knowledge of my Creator ?

TUT. From his works, and from his word.

PUP. Has not God revealed himself to us in the bible ?

TUT. Without doubt. But when you can see as it were with your own eyes his adorable perfections, it is certainly your duty to view his works, as well as to read his word.

PUP. Has this been the practice of wise and good men in former ages ?

TUT. Yes ; Moses, Job, David, Isaiah and others. Solomon in particular, we find, spoke of trees and beasts, of fowl, and of creeping things, and of fishes. The Saviour himself also has directed

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trees

2 THE CATECHISM OF NATURE.

ed our attention to the works of nature. " Behold the fowls of the air ! consider the lilies of the field, how they grow !"

PUP. What may I expect from contemplating the works of nature ?

TUT. Both profit and pleasure. As God has formed the eye to behold the beauties of nature, it must be both agreeable and useful.

PUP. Is not this a pleasure confined to the learned ?

TUT. By no means ; the peasant as well as the philosopher may partake of this pleasure. A moderate share of knowledge is sufficient. The creation is open to the view of all ; it only requires observation.

PUP. What may I expect to find in the works of God ?

TUT. Whatever is wise, great, good, and perfect. God beheld every thing that he had made, and saw that it was good.

PUP. And do they continue so ?

TUT. All to this day answer the designs of the Creator, if we except the change which the fall occasioned.

DIALOGUE II.

PART I.

ON THE FIRMAMENT AND THE HEAVENLY BODIES.

PUPIL. Which of the works of God should first engage my attention ?

TUTOR.

TUTOR. If you would first view the greatest of God's works, you must turn your eyes up to the firmament, that wide boundless space, in which are fixed the earth, the sun, the moon, the planets, the comets, and the stars.

PUP. What are the principal qualities of the firmament ?

TUT. Extent and transparency. It must be very extensive to contain the innumerable heavenly lights ; and transparent, otherwise we could not see them ; its extent cannot be computed ; and the transparency of the firmament is equally amazing.

PUP. What stars are those which we see in a clear evening ?

TUT. They are great bodies of fire, like our sun, but on account of their immense distance appear so very small.

PUP. How many stars are there in the firmament ?

TUT. The number we see with the naked eye is not considerable : but, as the better our glasses are, the more we see : to speak in the language of men, " they are innumerable."

PUP. Why do they twinkle ?

TUT. That appearance is occasioned by intervening vapours floating in the air.

PUP. The stars appear to be placed without any order.

TUT. They appear so, because we see them but in one point of view ; but they are certainly arranged

4 THE CATECHISM OF NATURE.

in the most exact beautiful order ; for they were arranged by God, who is order and beauty itself.

PUP. Did God create the stars only for our use ?

TUT. It is unreasonable to suppose it, on account of their vast distance : but they were probably created to enlighten other worlds, as the sun enlightens ours.

PUP. Are the stars then suns like ours ?

TUT. Yes, such is the common prevailing opinion of philosophers.

PUP. Are they in no degree serviceable to us ?

TUT. They serve to enlarge our ideas of the works of God, to diminish the gloom of darkness ; they are of service also to mariners ; that one particularly so, which is called the north pole star, which always has one and the same position in the heavens.

PUP. But let us speak of our own sun, if you please, sir, and of our own system. How large is the sun ?

TUT. Ten hundred thousand times larger than our earth.

PUP. How far, do you suppose the sun to be from the earth ?

TUT. Ninety-five million, one hundred, and seventy three thousand English miles.

PUP. What an amazing distance ! Would it not be better, if the sun was nearer us ?

TUT Our all-wise Creator could not mistake. He has exactly adjusted its proper place : if it were nearer

nearer we should be burnt ; if farther off, we should perish with cold.

PUP. What benefit do we receive from the sun, beside its affording us light ?

TUT. By its warmth and heat it promotes vegetation, cherishes animal life, and raises the vapours from the sea, without which we should have no rain.

PUP. Of what nature, or quality, is light ?

TUT. It is an emanation of rays from the sun, spreading themselves with inconceivable velocity through the ether. Light is exceedingly fine and subtle ; it penetrates through glass, and is diffused over the whole world.

PUP. How does it appear that the rays of the sun partake of the nature of fire ?

TUT. It appears from hence, that when collected in a burning glass, they produce similar effects, and will set things on fire.

PUP. Is there any thing more particular in these rays ?

TUT. They are the cause of all the different colours we see, of the morning and evening twilight, and of the light coming into our houses.

PUP. What am I to understand by the morning or evening twilight ?

TUT. The gradual slow increase and decrease of the sun's light ; without which we should pass instantly out of dark night into clear day, and the light would as suddenly leave us.

PUP. Would that be prejudicial ?

6 THE CATECHISM OF NATURE.

TUT. The eye could not bear such a sudden transition as the former, and the latter would often perplex and distress us: against both these inconveniences God has wisely provided, by this twilight.

PUP. How, or by what means does the light enter our houses?

TUT. By the wonderful property of refraction, or bending of its rays out of their right line; by which means our rooms are enlightened.

DIALOGUE II.

PART II.

PUP. Are there not other lights in the firmament?

TUT. Yes: but they shine only with borrow'd light, and are called planets.

PUP. What are the names of those planets?

TUT. That, which is nearest the sun, we call Mercury; the next Venus, then our Earth with its moon: still farther from it, are Mars, Jupiter, and Saturn, with their moons, which are all enlighten'd by the sun.

PUP. Has not a new planet been lately discovered?

TUT. Yes, by the king's astronomer, Mr. Herschel; who has called it in honour of his royal patron, Georgium Sidus.

PUP. Our earth has a moon; have the other planets moons too?

TUT. Jupiter has four, Saturn five, and Georgium Sidus two, as lately discovered by Mr. Herschel's

chel's new invented telescope. Some have thought that Venus has a moon, as Fontana, and Cassini : and Short, in the year 1740, saw an illuminated speck near this planet, which he supposed to be its moon. Three French astronomers saw the same in the years 1761, and 1765.

PUP. How are those planets, to be distinguished from the stars?

TUT. The stars twinkle : the planets shine with a steady light. The planets also, are continually changing their positions in the heavens; but the stars keep their respective places, and are therefore called the fixed stars.

PUP. In what manner do the planets move?

TUT. They all move round the sun; but not in the same orbit, nor in the same time.

PUP. In what time does the earth revolve round the sun?

TUT. In three hundred and sixty-five days, which makes our year : and though it revolves with incredible swiftness, we are yet insensible of its motion.

PUP. Why are we not sensible of its motion?

TUT. Because the air which encircles the earth (which we call the atmosphere) is carried along with it; and all surrounding objects move with us at the same time.

PUP. Why is it not always equally warm?

TUT. The inclination of the earth's axis as it moves round the sun, is the occasion of the various seasons; Spring, Summer, Autumn, and Winter.

8 THE CATECHISM OF NATURE.

This I shall explain to you in my future lecture on astronomy.

PUP. Has the earth any other motion?

TUT. Beside that round the sun, which we call its annual revolution, it has another motion round its own axis, once in twenty-four hours, which makes our day and night, this we call its diurnal revolution.

PUP. Does the moon move round the earth?

TUT. Yes, in twenty-four days, and continually attends upon the earth, during its whole revolution round the sun.

PUP. Why do we not always see the moon?

TUT. When it is on that side of the earth next the sun, then the dark side of the moon is towards us, for which reason we are not able to see it.

PUP. What am I to understand by an eclipse?

TUT. When the moon's shadow falls upon the earth, we call that an eclipse of the sun, because the moon prevents our seeing the sun, more or less, according to the extent of its shade. And when the shadow of the earth falls upon the moon, we call that an eclipse of the moon. Observe, an eclipse of the moon can only happen when it is full moon, and an eclipse of the sun when it is new moon.

PUP. As the moon, you say, is a dark body of itself, do we receive any benefit from it?

TUT.

TUT. Yes, from its reflecting to our earth, the sun's light ; which is so particularly pleasing and useful during the long dark nights of winter : what a singular mark of the divine goodness, thus to provide for us in the absence of the sun !

PUP. Have we any other advantage from the moon ?

TUT. Yes, it is together with the sun, the cause of the ebbing and flowing of the sea, which tends to purify it ; and the tides are very useful for navigation.

PUP. Is the moon inhabited ?

TUT. Some philosophers suppose it is ; and that our earth serves as a moon to them. For you may see plainly yourself, that our earth reflects the sun's light on that side which is not illuminated : this you may perceive every new moon ; but more in the winter than the summer months.

PUP. Do you also suppose then, the planets of other systems, to which the stars are suns, are inhabited ?

TUT. Without doubt. Such an idea is truly philosophical, grounded upon reason and analogy. As there is such an amazing variety and gradation in the animal species, so it is not to be supposed that angels and men are the only intelligent beings in the universe.

PUP. But might we not expect the bible to have given us some light upon this subject ?

10 THE CATECHISM OF NATURE.

TUT. The bible was not designed to teach us astronomy, geometry, or mathematics. It gives us a minute relation of the formation of our own system—and that the other parts of the universe are innumerable. Philosophical researches soar above the level of common understandings. Moral truth is of more intrinsic value—and an humble, obedient heart,—worth all the stores of human learning.—But we are losing sight of our subject. What question did you next design to ask me?

PUP. What idea am I to form of the comets; are they bodies of fire?

TUT. No. They receive their light from the sun, which is apparent from their shining train.

PUP. Is not that train, or tail, fire?

TUT. It is conjectured to be only its atmosphere, enlightened by the sun.

PUP. Are not the comets supposed to pass far beyond the limits of our system?

TUT. Yes, which serves to give us a very enlarged idea of the extent of the firmament. The period of that comet's revolution, which appeared in 1759, was computed at about seventy years. And that which was seen in 1680, has been shewn to have a period of more than five hundred years. The orbits of more than fifty comets have been fixed with sufficient accuracy to ascertain when they may be expected to appear again.

PUP. Are the comets supposed to be inhabited?

TUT. All that we can say is conjecture; if they

are inhabited, the beings who live there must be very different from those we have been conversant with. Some are of opinion they are only intended as a supply for that diminution which the sun must suffer by the unceasing emission of its particles of light and heat.

PUP. Do these comets prognosticate evil?

TUT. Many people are frightened at their appearance, as if they portended some public national calamity; but without any foundation; for peace, plenty and prosperity have followed their appearance, as well as war, pestilence or famine. "Be not dismayed," saith the Lord, by his prophet Jeremiah, "at the signs of the heavens, "for the heathen," the ignorant, "are dismayed "at them."

DIALOGUE III.

ON THE AIR, WIND, RAIN, &c.

PUP. I often hear of the air; what idea am I to form of an element that is invisible?

TUT. It is a fluid, which agitates bodies when it is in motion. In a word, it has the properties of rarity, transparency and elasticity; and when compressed, has an amazing power, similar to the expansion of gun powder.

PUP. Has the air any more peculiar properties?

TUT. It conveys sound, and is necessary to give us the sense of hearing; without air, we should have

12 THE CATECHISM OF NATURE.

have no music, no smell, no light, nor be able to converse with each other.

PUP. What is the wind ?

TUT. The wind is nothing more than a part of the air, put into motion less or more.

PUP. From what cause does this arise ?

TUT. Principally from warmth or cold which is excited in the air. Heat expands the air, and cold condenses it.

PUP. Have you any particular names, by which to distinguish the winds ?

TUT. According to the quarters from which they blow ; East, West, North, and South.

PUP. Will you please to tell me how to find these quarters ?

TUT. If at noon you stand with your back to the sun, the east is on your right hand, the west on your left, the north directly before you, and behind you, the south ; or at night, if you stand with your face to the pole star,—the east is still on your right hand, the west on your left, and north and south, as just now mentioned.

PUP. Of what use are the winds ?

TUT. The benefits arising from the winds are almost innumerable ; they purify the air, moderate the heat, dry wet lands, and damp houses, chase away the fogs and hazy weather, and bring us the rain in due season ; also, frost and snow, and milder weather. They are particularly serviceable for navigation and commerce.

PUP.

PUP. What are vapours, or clouds ?

TUT. Vapours are either thin, invisible, moist particles which float in the air; or, being more condensed, and by that means rendered visible, are called clouds. This work of the Creator was observed of old. "He bindeth up the waters in his thick clouds, and the cloud is not rent under them."

PUP. From whence do the vapours arise ?

TUT. They are drawn up, by heat out of the earth, and by their lightness hang in the air.

PUP. Of what use are these vapours hanging in the air ?

TUT. They cool the air, when it is too hot; they afford us agreeable shades, when form'd into clouds; prevent the earth from becoming too dry; and water it with refreshing rain.

PUP. What is the natural cause of rain ?

TUT. When the air is so full of heavy vapours that it can no longer sustain them, then these small moist particles, adhering together, fall down in fine drops, which we call rain; which heat, cold, and wind, contribute to produce; and the rain falling in drops is a further manifestation of divine wisdom; for if it fell in strong streams it would injure the earth, by washing away its fine light mould from the roots and seeds; and we should suffer great inconvenience from it.

PUP. What brings the rain ?

TUT. The winds, which at God's command convey the clouds over the whole earth.

PUP.

14 THE CATECHISM OF NATURE.

PUP. What benefit do we derive from the rain ?

TUT. It makes the earth fruitful, it refreshes the withering plants, it cools the air in summer, it supplies our springs, and forms our rivers, so that we are never in want of water.

PUP. Are there any signs or tokens of approaching rain ?

TUT. Many ; we can foresee its approach by the wind, by birds, planets, &c.

PUP. How comes the cold or frost ?

TUT. Generally by the wind, which blows from the continent ; and the stronger the wind, the severer the frost.

PUP. How is the ice formed ?

TUT. By an extraordinary degree of cold, which congeals the water into a firm substance.

PUP. Of what use is frost ?

TUT. God has wise designs in all his operations ; and the frost is not without its use ; it clears the atmosphere, it braces and strengthens the human frame, mellows the clay ground, and fertilizes it, destroys hurtful insects, and serves other useful purposes.

PUP. What is snow ; and of what use ?

TUT. It is nothing but water in another form ; white and light, and falls in the most beautiful figures ; which every person may see, who will but view the flakes of snow attentively. As to its use : it preserves the corn from being chilled by the frost ; therefore, said David, that pious contemplator of nature,
" He

“He giveth snow like wool;” it hinders the frost from penetrating too deep into the earth. Snow is also a manure to the earth, from the nitrous particles it contains; and, by its colour, diminishes the darkness of our long winter nights.

PUP. What is hail?

TUT. Nothing more than drops of rain congealed by greater degrees of cold.

PUP. Are not mists and dews wholly useless?

TUT. By no means; they refresh and invigorate weak and withering plants, in time of scarcity of rain.

PUP. How do they arise?

TUT. They are vapours arising from the earth, condensed by colder air, and thus become visible.

PUP. What is hoar frost?

TUT. It is like hail, only vapours congealed, and wisely ordained for the preservation of trees and herbs. The hoar frost is scattered like ashes. This also, as well as the snow, falls in very beautiful forms, which are well worth minute inspection.

PUP. What idea am I to form of thunder and lightning?

TUT. Lightning is occasioned by the elastic matter in the clouds, which encounter each other in the air—and burns instantaneously like gunpowder, accompanied with that awful roll, or sound, which we call thunder.

PUP. Is thunder indeed nothing more than sound;

16 THE CATECHISM OF NATURE.

found; then I need not to be afraid of what we call thunder-bolts?

TUT. That is only a vulgar mistaken idea. All the danger arises from lightning—and even that is not dangerous when at a distance.

PUP. How, am I to judge of its distance?

TUT. By the interval between the flash and the stroke. If that interval is considerable, it is distant, and then not dangerous—but when the stroke almost instantly succeeds the flash, it is then near, and consequently the greater the danger.

PUP. Have you not told me it is dangerous to go under trees when it lightens?

TUT. Yes, because trees very much attract the lightning. It is better to continue in the open field or public road (if no house is near) than to take shelter under trees.

PUP. Is lightning of any use?

TUT. More so than many are aware of. It consumes noxious vapours—it promotes a circulation of the air—it brings on rain at a time when it is often most wanted, and cools the heat of summer. “Fire and hail, snow and vapour fulfil his word.”

PUP. I thank you, I shall not be afraid of the lightning, as I used to be; but what occasions the beautiful rainbow?

TUT. The rainbow with its beautiful colours is occasioned by the rays of the sun shining upon the falling drops.

DIA-

DIALOGUE IV.

ON THE EARTH.

PUP. For what purpose was the earth created?

TUT. God formed the earth to be inhabited, and millions of living creatures are in every part of it.

PUP. On what do you suppose the earth to stand?

TUT. It stands not upon any thing—if it did, how could it move? Hear the poetical language of Job: “He hangeth the earth upon nothing.”

PUP. Does this globe then, which we inhabit, continually hang and move in the air?

TUT. Certainly it does, as well as the other planets.

PUP. What an amazing power must it be which fixed them, which first set them in motion, and which still keeps them there!

TUT. God made the earth by his power—he established the world by his wisdom—and stretched out the heavens. On what faith the earth’s Creator are the foundations thereof fastened? or who laid the corner-stone thereof, when the morning stars sang together, and all the sons of God shouted for joy.

PUP. Of what are these material things chiefly composed?

TUT.

18 THE CATECHISM OF NATURE.

TUT. Of earth, air, fire and water.

PUP. What does the earth consist of?

TUT. It consists of fine mould, stone, clay, sand, minerals, metals, fossils, &c.—which have each their respective well-known uses. But they are, most of them, hid from our sight, by the green plants and herbs.

PUP. Why is the firmament blue—and the produce of the earth green?

TUT. In this appears the Divine care for our welfare. These two soft, pleasing colours are agreeable to the eye—and neither weary nor injure the sight, as some other colours do.

PUP. How many sorts of metals are there?

TUT. Six: gold, silver, copper, tin, lead and iron.

PUP. Why are all these under the surface of the earth?

TUT. If they were above, or upon the surface, they would occupy the best part of the earth—and prevent our cultivating it. As they now lie in subterraneous magazines, they are no hindrance to agriculture.

PUP. Which is the most useful of these metals?

TUT. Iron.---Gold may purchase iron---but it will not serve as a substitute for it, because it is not a metal equally hard. Gold would not serve for our ploughs or anchors. In a word, not one thing you have about you is made without the assistance of iron.

PUP.

PUP. What other valuable things are to be found in the earth's grand magazine?

TUT. That valuable fuel for fire, coals, without which we could neither dress our victuals, nor comfortably pass our winter evenings, and which mechanics also find so very useful.

PUP. When such a vast quantity of this fuel is consumed every day, how great must be the store, which our kind Creator has made for our use?

TUT. Inconceivable! consuming every hour, night as well as day---and yet these treasures not exhausted.

PUP. Is coal equally plentiful in all countries?

TUT. No. If every country produced exactly the same things, there would be no commerce, no intercourse, between distant nations.

PUP. Are there any other valuable things to be found in the earth's storehouse?

TUT. Quick-silver, chalk, brimstone, limestone, salt, clay for bricks, pipes, and what is usually called earthen-ware---Marble, stone, chrystals, diamonds and magnets, or load-stones, which are so peculiarly serviceable to navigation.

PUP. What a rich treasure the earth contains below its surface---and all for the use of man!

TUT. Rich indeed! How thankful ought we to be to our bountiful Creator, who has provided so many good things, and in such great variety for our use and pleasure.

DIA-

DIALOGUE V.

PART I.

ON MAN.

PUP. Which am I to consider as the noblest work of God?

TUT. Intelligent beings, such as angels and men. I shall now speak only of the latter.--- Though man is inferior to angels, he is the noblest creature on this earth. For God made him the Lord of this lower world—and put all things under his feet. He exceeds other creatures in beauty of form, of limbs, of countenance—in speech, in his erect posture, and as having a rational soul. For God taught man more than the beasts of the earth, and made him wiser than the fowls of heaven.

PUP. Will you be so kind as to give me some information concerning the human body.

TUT. The most striking part of the human body is the face, and one peculiar proof of divine wisdom, is, that every human face should be so readily distinguished from another, else the innocent might sometimes suffer for the guilty.

PUP. This I never before attended to. Pray why is the head formed of a harder substance than the rest of the body?

TUT. That so tender a part as the brain (the seat of reason) may be securely preserved.

PUP. Is the hair of the head merely ornamental?

TUT.

TUT. No. It not only keeps the head warm, but it serves to keep open the pores---to let out the evaporations through their own hollow tubes---and serves also for its defence from violence.

PUP. Are the hairs hollow?

TUT. Yes, this you may see with the microscope.

PUP. What have you to tell me of the eye?

TUT. It is one of the most artfully constructed parts of the human body. Leaving the internal construction of the eye to the anatomist, I shall now only make the following remarks.---That the eye is moveable in its socket, that we may be able to see on every side without moving the head :---That by its position it is well secured from injury:---That when we have too much light, it has power to contract the apple, or pupil of the eye, to ward off its too numerous rays. And again, when there is but little light, then it can enlarge it to receive more rays.

PUP. Of what service are the eye-lashes?

TUT. To moderate the strong light, and to preserve the eye from flying insects.

PUP. Of what particular service is the eye-lid?

TUT. The eye-lid is as a curtain to be drawn up by day---and to be let down at night when we sleep, that we may enjoy our rest with greater security.

PUP. What is the benefit of the eye-brow?

TUT. It is wisely formed to keep off the dust and sweat, which would give the eye exquisite pain, beside being detrimental to the sight.

PUP. Is not the ear also curiously formed?

TUT;

22 THE CATECHISM OF NATURE.

TUT. It is a most wonderful construction indeed; but for a knowledge of this too, you must wait till you are a little older. It is now sufficient for you to know that the ear is made of a gristly substance, to stand almost stiff to catch the sound, and to conduct it within the auditory tube.

PUP. What is the cause of our being able to understand one another instantaneously?

TUT. That we may have an immediate perception of each others words, God has given to sound a swiftness twice as great as that of a ball that issues from the mouth of a cannon.

PUP. Astonishing indeed! but you have not mentioned the sense of smelling.

TUT. Our wise Creator has placed this sense in a part projecting above the mouth, that we may perceive what is pure and good by its own fragrance; and discover what is not sound and wholesome before it enters the mouth. The nostrils, wisely adapted to this end, are rather broad below to receive the smell. Through these also pass the sharp humours of the head---and when during the time of our eating, we cannot breathe with the mouth, we can breathe through the nostrils.

PUP. What is there observable concerning the taste and the sense of feeling?

TUT. It enables us to judge of good or bad food, and affords us much pleasure. Owing to this it is, that hunger ceases, as soon as we have eat enough. If it was not so, we should often eat more than is
good

good for us. The sense of feeling is spread over the whole body, whereas the other senses have their residence in the head.

PUP. Where are the senses the strongest?

TUT. Where they are most wanted. For instance, on the tip of the tongue, the lips-- the ends of the fingers, the hands, &c. Our senses are set as faithful guardians for our preservation; and when we lose one sense, we often find that another grows the stronger: as in blind people, it is observed that the hearing becomes more acute.

PUP. What merits our further attention in the head?

TUT. The tongue, that wonderful instrument of speech, from which arises so great a part of our earthly happiness. It is also well adapted to assist the chewing of our food, to mix it with the saliva, so necessary for digestion---and to help it in the passage to the throat---And without the tongue we could have no vocal music.

PUP. The use of the teeth I need not ask you; but what prevents them from wearing away by such incessant labour?

TUT. A fine enamel with which they are covered. For when this wears off, the teeth decay, and hence arises the common complaint the tooth-ache. But, beside their use in chewing---you may not perhaps have observed that they contribute to the formation of our speech: for they who lose many of their teeth are not so easily understood.

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24 THE CATECHISM OF NATURE.

The lips also serve for the same purpose—hence some of our letters are called labials. Beside this, with the lips we receive and taste our food.—But suppose we here pause a little, lest I weary your young mind.

PUP. I am not weary, but I submit to your pleasure.

DIALOGUE V.

PART II.

ON THE HUMAN BODY.

TUT. We now proceed to the throat.--- In this is an open tube, which we call the wind-pipe, thro' which we breathe. Behind this is another called the gullet, through which the food passes into the stomach.

PUP. Must not then our food pass over the open wind-pipe, and consequently be in danger of falling in?

TUT. So you might well think. But God has provided against this. Behind the root of the tongue we find a muscular membrane * which closes the wind-pipe whenever we attempt to swallow any thing, over which the food passes, as if it went across a bridge.

PUP. A crum of bread gives us pain in the throat sometimes, from whence does that arise?

* Called the Epiglottis.

TUT.

PUP. From its falling into the wind-pipe (or as we commonly say going the wrong way); but this does not happen often, unless we laugh or talk while we have our mouth full of food. Great wisdom is also discernible in the structure of the neck. It is formed with so many joints, that we can easily turn the head without moving the whole body: and is provided with stiff bones to keep the head upright, without which man would lose much of his grace and dignity.

We now descend from the head and neck to the body. The larger bones may be considered as the great pillars of a building:—The muscles, or the fleshy parts, as so many cords to bring every thing into motion:—The arteries and veins as the streams of refreshment and the springs of life.

The heart, in the middle, as the fountain or working machine, conveys the blood by means of the arteries to the extremities, which is returned back by the veins; and the continual pulsation of the heart keeps up the perpetual circulation of the blood. The lungs are instruments to admit good air to cool and refresh the blood---and to let the air out when it has performed its office. The stomach is a great laboratory, where every thing is prepared that can serve to the necessary recruiting of the whole body. The arms, hands and fingers, may be considered as the guardians of the body, the house, and also to labour in the various duties of life; the fingers are therefore formed with small bones and strong muscles, to move with the greater ease.

26 THE CATECHISM OF NATURE.

PUP. Is not the right-hand formed with more or stronger muscles than the left?

TUT. That we can do more with the right-hand is only owing to habit---because we have been accustomed from our infancy to use that more than the left.

PUP. Have you any thing more particular to observe here?

TUT. It is worth attention to remark, that the skin of the hand becomes thicker, that it may not be worn out by working, and yet does not entirely lose its feeling. The same may be observed of the soles of the feet. The position of the thumb also gives additional strength to the fingers, by enabling them to keep firmer hold of any thing. And further, you may also consider---what works of art, such as writing, drawing, painting, and instrumental music, are performed by these five small members of the human body. And to crown and perfect the human fabric, the whole body is covered with a fine skin, as a curiously wrought upper garment without a seam; through which are an infinite number of invisible spiracles or apertures, which we call pores.

PUP. Of what particular use are these pores?

TUT. Through these evaporate the superfluous moisture of the body, which we usually term perspiration; the regularity of which is so necessary for the health of the body, that when perspiration is stopped, it throws the body into uncommon heat,

which we term a fever, and which is so often fatal. Exercise and cleanliness are the best promoters of this necessary perspiration.

DIALOGUE V.

PART III.

OF THE INTERNAL PART OF THE HUMAN BODY.

PUP. I should now be glad if you would give me a clear idea of those parts of the body which are not visible to the eye ; I mean its internal parts.

TUT. The principal internal parts are ; first the stomach, a wide paunch in which the food (that has been chewed in the mouth) is dissolved. To facilitate the dissolution of which, it receives in its progress a liquor from the gall bladder. The next thing observable is, the bowels, which receive the food from the stomach, push forward the softer parts, and absorb all the fine juices, by means of numerous absorbent vessels called lacteals which are placed in the bowels, and are of curious construction. The bowels are near thirty feet long, but by their various foldings take up but a small compass.

PUP. What becomes of the grosser parts of our food?

TUT. When all the nourishment is drawn from it, those grosser parts pass onward to be discharged from the body.

PUP. And how or in what manner is the body nourished by food?

28 THE CATECHISM OF NATURE.

TUT. The fine juices (called chyle) are conveyed by means of the mesentery, to the heart, to be formed into blood.

PUP. How is all this work effected?

TUT. The heart receives these juices, and injects them into the lungs, and the lungs press and prepare them. The air, drawn in by the lungs, passing through the windpipe, expels the inflammable parts in the act of breathing, and the lungs return the juices back to the heart, and they are thus converted into good blood, which nourishes the whole body.

PUP. What gives the blood its motion or circulation?

TUT. In that lies the grand secret, termed life.—Our Creator has given to the heart a power of opening and of closing its cavities, which we call its expansion or contraction.—And as long as this continues we live. By the former the blood is brought in, and by the latter sent forcibly out into a duct, called the great artery. It is supposed the pulsations of the heart are more than two thousand every hour, whether we wake or sleep.

PUP. I am lost in wonder and admiration!

TUT. Adopt the words of the psalmist, who was much employed in meditating on the works of God, “I will praise thee, for I am fearfully and wonderfully made. Marvellous are thy works, and that my soul knoweth right well.”

But I have one thing more to call your attention to, which will also excite your astonishment. It is this, If the blood (which is brought again to the heart,
into

into its other cavity, from the extremities of the feet through the veins), was ever to flow back, we should die; so God hath provided against such an accident, by placing in the veins, small fluices or valves, which permit the blood to pass forward, but effectually prevents its return.

PUP. David might indeed well say, that we are fearfully and wonderfully made.

DIALOGUE V.

PART IV.

OF THE HUMAN SOUL.

TUT. Having spoken so largely of the body, I shall now proceed to give you some account of the soul. This is far superior in excellence and dignity to the body on account of its spiritual nature, its intellectual and moral powers—and its immortal duration.

PUP. What are those powers?

TUT. They consist in forming ideas, thinking, reasoning, judging and willing. And it possesses, besides, the powers of memory and imagination.

PUP. Has the soul any passions?

TUT. Yes, such as joy, love, desire, hope.---And a sense of honour. It feels pity and compassion. It has also the passions of fear, shame, grief, anger, &c.

30 THE CATECHISM OF NATURE.

PUP. Are these passions beneficial to us?

TUT. Without doubt, when under proper regulation. They were designed by our all wise Creator to excite us to moral and pious actions. But if these passions are not under proper discipline, they may lead us to much evil, and expose us to great injury. "He that hath no rule over his own spirit is like a city broken down, and without walls."

PUP. Is it known how the soul is united to the body?

TUT. That surpasses the conception of the wisest philosophers.

PUP. But must not man die, though such a noble creature? What a pity that so beautiful a fabric should crumble to dust!

TUT. Every day's experience proves our mortality, but the gospel gives us the strongest assurance that good men will be raised again with more perfect bodies, and placed in a state of happiness that will never end.

PUP. As men are dying perpetually, is there not some danger of the world's losing all its inhabitants?

TUT. Though from calculations which have been made, sixty are supposed to die every minute, yet more than sixty are supposed also to be born every minute. And for every hundred females born into the world, there are also born one hundred and five males, as more of the latter are supposed to die in earlier years than the former, and many by wars.

PUP.

PUP. Do more men die in the country than in very populous cities?

TUT. More in cities; because there the air has not that free circulation it has in the open country, consequently it is not so pure for breathing; besides, infectious disorders more easily spread their baneful influence, and are more readily communicated, when habitations are so contiguous to each other, and the streets and lanes are very narrow, and crowded with inhabitants. But wherever we live, whether in town or country, we breathe God's air, we enjoy his light, we live upon the produce of his earth---in short, all that we have is the Lord's. It must therefore be manifestly our duty to serve him, both with our bodies and our spirits which proceed from him.

DIALOGUE VI.

ON LAND AND WATER.

PUP. Would not the earth be more beautiful, if it was one smooth extended plain, without hills and mountains—Do not the mountains disfigure it?

TUT. By no means. Do you think the dust that falls upon the Geographical Globes disfigures them? The mountains are no greater in comparison with the whole earth, than the dust to the globes; or the roughness of an orange. Without mountains we should have no springs nor rivers; they receive

32 THE CATECHISM OF NATURE.

ceive the vapours, the rain and the snow, which supply the springs with water. Mountains are the grand magazines of metals, minerals, marble, stone, &c. and besides attracting the clouds, they shelter the low-lands and vallies from the bleak and cold winds.

PUP. What is the use of those sand-hills which are so numerous upon the coast of Holland, and upon which nothing grows?

TUT. They serve to hinder the boisterous waves of the sea from over-flowing the Low Countries.— This is worthy your reflection, that small grains of sand, which you can blow away with your breath, when thrown into a mass, form such a strong barrier against the raging ocean. “ Will ye not tremble, “ faith the Lord, at my presence, who have placed “ the sand for the bound of the sea, by a perpetual “ decree that it cannot pass it— and though the waves “ thereof toss themselves, yet can they not prevail— “ though they roar, yet cannot they pass over it.”

PUP. I should wish now, if you please to turn my thoughts from the land to that great body of water, the sea. What is there worthy my observation?

TUT. Its extent—its depth—its saltness—its ebb and flood—and its limits or boundary.

PUP. How large is the sea?

TUT. It takes up two thirds of the whole earth.

PUP. Why is it so extensive?

TUT.

TUT. For wise purposes no doubt. Some philosophers think it may serve as a balance to the land. It is a grand reservoir of water, from which millions of tuns are raised up by the warmth of the sun, to form clouds and rain, to supply the whole earth with water.

PUP. There seems then a continual circulation in the material world, as there is in the animal body.

TUT. You judge right. The rain forms the springs, the springs form the rivers---the rivers run into the sea. The sea furnishes the rising vapours, the vapours form the clouds, and the clouds give the rain. This reciprocal succession began with the creation, and will continue to the end of the world.

PUP. What am I to understand by the ebb and flood of the sea, or the rising and falling of the tide, as it is commonly called?

TUT. That this amazing collection of waters, rises every six hours, more or less, which is called flood—and after a very short time of rest, falls again, which we call the ebb.

PUP. What is the cause of this regular movement of the waters, and what is its use?

TUT. The ebbing and flowing of the sea is supposed to be occasioned by the motion of the earth, and the attraction of the sun and moon, which you will be better able to comprehend when you grow older---this movement of the water preserves it from corruption, which would take place if it was in a state of

34 THE CATECHISM OF NATURE.

rest and stagnation. The great usefulness of the sea for a quick and speedy intercourse with distant nations—for navigation and commerce, is almost inconceivable---the tides are also exceedingly useful for navigation and commerce.

PUP. Is not the depth of the sea very great?

TUT. It is not of equal depth---in some places navigators can find no ground with a line of more than seven hundred and eighty fathom.

PUP. Why is the sea so deep?

TUT. God, who meted out the heavens with a span, also measured the water in the hollow of his hand—he adjusted it in wise proportion no doubt to the land---and for this reason it may be so large and deep. By its depth it contains much more water, and there remains so much more dry land.

PUP. Why is it so salt?

TUT. To preserve it pure, and to yield us so valuable an article of life.

PUP. Does the sea then produce salt?

TUT. A great quantity of salt is taken out of holes dug on the sea-shore, from whence sea-water is exhaled by the sun, leaving behind the salt which it contained.

PUP. How beneficial is the sea for man!

TUT. But surely you have not forgotten the great benefit man receives from that vast inexhaustible store of fish which it contains, great and small, from the whale even to the shrimp---for even those which are not good for food, are useful for the wants and conveniences of life. Neither surely, have you forgot-

forgotten the extensive general benefits of commercial intercourse, carried on upon its surface, between the most distant nations of the earth---the support which it is the means of affording to ship-builders—and for so useful a body of the community as sailors.

PUP. What confines and keeps the sea within its proper bounds?

TUT. The Divine Ordination. The same all-creating Word which said, “Let there be light, “and there was light:” said also to the raging sea, “Hitherto shall thou come, but no further, and “here shall thy proud waves be staid.”

PUP. What an immense quantity of vapour must be raised out of the sea to supply the springs which form so many great rivers in every quarter of the world! But how is water raised into the air, which I have heard you say is much heavier?

TUT. This merits your attention. Though water is, as you remember I told you, heavier than air, yet it is capable of being made lighter than air, and then it will ascend. The water which you see daily on the kitchen fire would all evaporate in steam when boiling; this familiar occurrence may serve to give you some idea how water may be made to ascend in the air. Our philosophers tell us that a particle of water may be so rarified, that it may become ten times as large as it was before; and this you may have seen yourself without having observed it in this light, in the water-balloons which children
form

36 THE CATECHISM OF NATURE.

form with a pipe, which immediately ascend, being then become lighter than air: this shews that air will adhere to and mix itself with water.

PUP. But what is the principal cause of the ascension of these vapours from the sea?

TUT. The warmth and heat of the sun, by which the water is rarified---that fire is lighter than air, you may see from the velocity with which all flames ascend into the air.

PUP. What, is your opinion of fire?

TUT. It is as necessary and useful as air and water.

PUP. Where do you acquire it?

TUT. It lies hid almost in every thing, because we have continual need of it---there it remains in a state of rest—but when it is brought out of its resting place, it spreads itself amongst fuel, whether of wood or coals. It melts and softens the hardest metals, evaporates moisture, boils and roasts our meat, and warms our houses in the cold months of winter. Without fire, having no candles, lamps or torches, we should be without light too, as well as without warmth and heat.

DIALOGUE VII.

OF ANIMALS.

PUP. I should now wish to know something of the animal creation?

TUT.

TUT. God has created several hundred thousand sorts of living creatures. Some live in the water, some on the earth, and some in both, which last we call amphibious; and others are inhabitants of the air—but all are subject to the reason of man.

PUP. Why are they?

TUT. That they may be made useful to us; which otherwise they could not be, because of their superior strength.

PUP. Have animals senses as we have?

TUT. The four-footed beasts have five, and some of them stronger than ours; the smell in hounds, for instance, and hearing in moles.

PUP. How are so many millions of creatures supported and preserved?

TUT. Every day a table is (as it were) provided by God's providence for so many guests. Care is also taken that we cannot annihilate any one species of food which God has created.

PUP. Is there any thing further to be observed?

TUT. Each have their weapons of defence; and they know when they are sick, what is medicinal. They know the element in which they are to live, and their own proper food; they know how to build their habitations, (of this kind the beavers seem to approach the nearest to human sagacity) they are able to distinguish their enemies, and to understand each other.

PUP.

38 THE CATECHISM OF NATURE.

PUP. If they understand each other, have they then a language peculiar to themselves?

TUT. They have: this appears from the different sounds lions, bears, wolves, horses, &c. &c. make in different situations.

PUP. Have they passions like ours?

TUT. Yes; they have affection, joy, grief, sympathy; they have manifestly anger and resentment, jealousy, &c. It may here also be observed that the nature or disposition of each remains the same; the horse is spirited and full of fire, the lamb mild and gentle, the hare timid, and the dog watchful and faithful to his master.

PUP. O how much are we indebted to our kind Creator, who has made all these subservient to us.

TUT. And our thankfulness should rise still higher when we reflect that these living creatures are not only designed for our use, but for our food also, at least the greatest part of them. This consideration should induce us to treat the brute species with lenity—cruelty to them is ingratitude to God who formed them. On the contrary, we ought to take all proper care of them, and give them whatever is necessary for their support; and never injure them, by too severe labour and fatigue. “Thou shalt not muzzle the ox when he treadeth out the corn.” And again, “A righteous man regardeth the life of his beast.”

PUP. But of what use are the wild beasts of the forest?

TUT.

TUT. They are all serviceable in some degree ; some for food, others for clothing. The ravenous beasts of prey may prevent the too great increase of other noxious animals ; the wild beasts of the forest may also prevent man from retiring into deserts, and banishing himself from society and from usefulness. They serve also to shew us the greatness and variety of God's works, and the fine gradation there is from the smallest of the animal tribe, up to the lion, the elephant, and the rhinoceros ; and to shew us that providence extends its care even to the inhabitants of the wilderness. "Thou makest darkness, and it is night, wherein all the beasts of the forest do creep forth. The young lions roar after their prey, and seek their meat from God."

DIALOGUE VIII.

OF BIRDS.

PUP. Will you now be so kind as to speak of the feathered tribe ? I am delighted with the sweet notes of birds.

TUT. To enjoy this pleasure undisturbed, you must rise early in the summer season.

PUP. I have been taught by my parents to rise early to preserve my health ; and I find it contribute both to my health and pleasure.

TUT.

TUR. I hope then you will always rise with the lark: an early hour is the best also for reading, for meditation; and study. But to return to our subject. The production and the structure or formation of a bird, calls first for your attention.—Observe how it acquires its existence. Out of that matter or substance with which an egg is filled; and this effected after it has been impregnated only by a brooding heat. The structure of birds is also curious, and a proof of great skill and wisdom. How well adapted is their form for flying. The substance of their bones is much thinner than that of land animals, that they may be lighter and better able to mount in the air. And that the thinness of the bones should not render them weaker, the substance of the bone itself is stronger and harder.

With their pointed beak they can more easily cut the air: but what is most observable in birds, is, their being capable of flying in the air; and some of them with amazing rapidity, for which purpose their wings are curiously constructed. But the flight of birds is what we see almost every hour, and therefore, like most other things that are common, escapes our attention.

PUP. Our motion upon the earth from one place to another, with so much ease, and this too almost without our thinking of it, might well excite our admiration at the wisdom of our Creator: but the motion of birds in the air is still more surprising:

prizing: and I long to know something further of the structure of their wings, and in what manner they move and suspend themselves in the air.

TUT. I am glad to find in you an encreasing desire of knowledge; but this with many other things which we have only just touch'd upon, you will better be able to comprehend a few years hence.

PUP. I thank you, but will you tell me more now?

TUT. You were just observing that you are much pleased with the singing of birds: and does it not strike you with admiration too, that the tender throats of such small creatures, and those of the male particularly, should be able to form such shrill and variegated notes, while a great ox, or bull, can only bellow and roar. It is observable further, that as they have to fly through the woods, they are provided with a membrane to protect the eye, which we have not—And also, that their ears are placed more within, and covered with feathers to guard them against the pressing wind.

PUP. I do not perceive, that birds have any teeth to chew their food?

TUT. True. But to break their food small, they have beaks, as tough as horn, which are very long in those that fish under water, shorter in those that must peel seeds, and hard as iron in those of a stronger contexture.

PUP. Do not they sometimes perish for want of food?

TUT.

TUT. I believe not for want of food, unless in some extraordinary cases. "They sow not," saith our Lord to his disciples, "neither do they reap nor gather into barns; yet your heavenly Father feedeth them." And what is worthy your notice here, is, that those birds which lay not up any store for winter, are always reasonably provided for: not even the sparrows are forgotten before God. "He giveth to the beast his food, and to the young ravens which cry." Those birds which find not their proper food in one country, fly to another: These we call birds of passage—such as the stork, the crane, the swallow, the woodcock, the turtle, and some others, which leave their own country at stated periods, to go to more favourable climates, and return again on the change of the season.

PUP. That is truly amazing. How can they find their way over different kingdoms and seas?

TUT. Their wise and bountiful Creator has given them that knowledge which we call instinct. "The stork in the heaven knoweth her appointed time, and the turtle, and the crane, and the swallow observe the time of their coming."

DIALOGUE IX.

OF FISHES.

TUT. To what shall we next turn our attention? Suppose we now take a view of the inhabitants of the watery world. What think you of creatures living in an element which would be fatal to us, and which could not live upon the earth as we do? water is the dwelling place of millions of fishes.

PUP. How diversified are the divine works!

TUT. So exclaims the psalmist, "O Lord, how manifold are thy works, in wisdom hast thou made them all. The earth is full of thy riches. So is the great and wide sea, in which are things creeping innumerable."

The structure of fishes is entirely opposite to what is proper for the flying of birds. Different means must necessarily be applied to make birds and fishes move upwards and downwards in their different elements. A smooth long body, thick before, and gradually diminishing in bulk behind, is the best formed for swimming. And of this form are fishes.

PUP. How do they breath?

TUT. Not as we do. For the air comes in through the mouth, and goes out through the gills.

PUP. Have they senses?

TUT. The nostrils shew they have the use of smelling. Their feeling too is finer than ours, because

44 THE CATECHISM OF NATURE.

cause they sooner perceive the changes of the weather. Neither is their sense of sight prevented by the water, for which purpose their eyes are differently constructed from ours.

PUP. Of what use are the scales of the fishes?

TUT. To preserve them from being bruised, or crushed by the pressure of the water---and to guard them against the cold.

PUP. How do they dart forward so nimbly in the water?

TUT. By means of their tail, by the motion of which they push themselves forward.

PUP. Of what use are the fins?

TUT. To keep them in equilibrium, or with their belly downward—to turn on either side, or to stop their progress.

PUP. By what means do they rise or descend in the water?

TUT. They are enabled to do this by a white air-bladder, which they can dilate or contract at pleasure.

PUP. How does that occasion their ascent or descent?

TUT. Because, in the first case, they are lighter than water---and in the latter, heavier.

PUP. How are they supported?

TUT. They eat worms, and flies, and plants. And the large fish feed upon the smaller, of which our bountiful Creator has given such a vast increase,
that

that the spawn of a perch, would produce more than twenty-eight thousand. "And God said, let the waters bring forth abundantly."

PUP. Are there any fish which migrate in the water, as birds of passage do in the air at certain seasons?

TUT. Yes. Such as the sturgeon, salmon, herring, smelt, pilchards, and others; some of which come from the sea into our rivers, and others are found in shoals, in certain parts of the ocean—and, at certain times of the year. To which they are, no doubt, led by what we usually term instinct.

PUP. What a vast store of provision is here laid up for man!

TUT Thus you see how good and bountiful God is to us.---"He has put all things under our feet, "All sheep and oxen; yea, and the beasts of the field, the fowl of the air, and the fish of the sea, and whatsoever passeth through the paths of the sea. "O Lord! our Lord! how excellent is thy name in all the earth!"

DIALOGUE X.

OF INSECTS.

TUT. Let us now take a view of the smaller part of the living creation. What think you of those called insects?

PUP. I cannot say I ever thought much about them.

TUT.

46 THE CATECHISM OF NATURE.

TUT. But we should not overlook any part of God's creation.

PUP. Where do insects live?

TUT. Every where. In the air, the earth, the water, in wood, in stone, in shells, in mud, and in sand.

PUP. On what do they live?

TUT. Upon almost every thing---upon flesh, fish, flowers, herbs, filth and dirty slime, which is often seen upon the water in summer.

PUP. What parts of an insect are most to be admired?

TUT. Their fine beautiful eyes, their wings, their colour, their offensive and defensive weapons, &c. &c. If you look through a microscope, you will find that what we thought to be dust on the wings of a butterfly, consists of a number of beautiful feathers, arranged in great order.---The legs also of insects are worthy of peculiar attention. Those of a fly, for instance, by which it can walk up a window perpendicularly, or horizontally upon a cieling.

PUP. How can they do that?

TUT. By means of a glutinous matter, which enables them to keep their hold. But besides this, many bodies which appear plain and smooth to the naked eye, have a roughness, which their small and tender feet can catch hold of.

PUP. How are they propagated?

TUT. By eggs which they carefully hide in the most secure places in great quantities.

PUP.

PUP. Are not many insects injurious?

TUT. Some no doubt are. The locust, caterpillar, &c.—and some others. But that these may not be too numerous, great multitudes of them are destroyed by birds.—But even caterpillars, which we deem so pernicious, are yet very serviceable.—And I doubt not, but many other insects are useful for purposes which we are ignorant of.—The several members of this little tribe are (with some few exceptions) very industrious. From the labour of bees, we receive our honey and our wax. The former being lodged in warm apartments of their own forming.

PUP. And how can those creatures do what man cannot do? how can they make honey?

TUT. By flying abroad, and collecting together the very fine essence of flowers, both of the field and of the garden, which is done by their trunk, with which small tube they suck up the delicious syrrup as nature produces it, and then deposit it in cells.

PUP. Do they each know their own cell, and keep to that as their constant place of residence?

TUT. Bees are like a well-ordered community. They have a sovereign bee, to whom they are all under subjection. The laws and regulations of this industrious tribe are generally submitted to, and punctually observed. They all labour for the common good, and mutually assist each other. In
short

48 THE CATECHISM OF NATURE.

short, man himself may from them receive much instruction.---Their hastening to their hives in great numbers is a sure sign of rain.

PUP. Is it not cruel to put to death a whole community, and unjust to seize the fruits of their labour?

TUT. There is no injustice in appropriating the fruits of their labour to our use, because by their making more honey than they want, we perceive that a part was designed for us. And with respect to putting them to death; why may we not as well put these to death, as an ox, or a sheep. It is the number of the slain in one and the same moment, all perishing together that alarms our feelings; could we see as many cattle slaughtered in the field in one day, we should exclaim against it as an act of cruelty---but as these are killed at separate times, and in different places, it is in that proportion less sensibly felt.---However there is a method of taking the honey, without destroying the bees, and this is certainly the best method.

PUP. But how can they subsist during the winter if we deprive them of their honey?

TUT. We always leave them what is sufficient, or supply them as they are in want. So that what we take may be considered as a kind of superfluity which they can well spare.

PUP. Are not ants too, remarkable for their industry, regularity and order?

TUT.

TUR. They are a little people united like the bees; But may rather be termed a commonwealth, than a monarchy. Their sagacity is very conspicuous in the various methods they use to procure food, and their friendly contrivance to carry it home. The food they store up so carefully, is probably for their young, when they first come out of the egg, for in the winter they are supposed to be in a torpid state.

PUP. I have heard, I think, something remarkable concerning caterpillars.

TUR. Besides their beautiful form, in their first state, after some time they change their coat; and become beautiful butterflies.

PUP. But do not they produce our silk?

TUR. Without doubt: they are silk manufacturers. -- This they make of a gum, which they have in their inside in a small bag or bladder. In goldsmiths shops you may probably have seen Iron plates with holes, through which they draw the gold wire to its proper size. The silk worm, has under her mouth, something resembling such a kind of perforated instrument, thro' which she draws the gum. This supplies the materials, out of which she spins her thread, and by passing through those holes it receives its form and length.

PUP. How useful are these insects, which we are apt to despise!

TUR. More useful in their humble sphere, than some of the human species themselves. All useless members of society, may learn a lesson even from the tribe of insects.

D

PUP.

50 THE CATECHISM OF NATURE.

PUP. Are spiders of any use ?

TUT Our aversion to spiders, arises from their ejecting a poisonous matter, with which they kill their enemies. But I believe the quantity they can eject, though fatal to insects, would not produce to us any great injury. Spiders however disagreeable to us, are not without their use :---They catch and destroy many flies :—The webs which they spread over the trees in summer, in some degree preserve the fruit. And they may be more useful in our houses than we are aware of. They may inhale some noxious qualities of the air, which might otherwise become prejudicial to us. The webs which spiders form, particularly in gardens, are exceedingly curious—and deserve your accurate inspection.

PUP. How do the field spiders carry their first thread from tree to tree, or, across the lanes, as we often see in the summer ?

TUT. Some have thought, that the spider must fly, to do this: but she transports herself in this manner*.

“ She places herself upon the end of a branch,
 “ or, some other projecting body, and there fastens
 “ her thread : after which, she presses out more long
 “ threads which she leaves floating in the air ; These
 “ threads are wafted by the wind, from one side to
 “ another, and are there fastened by their natural glew:
 “ she afterwards draws them to her, to try if they
 “ are well fixed, and then they become a bridge over

“ which

Nature display'd.

"which the spider passes and repasses at pleasure."

Others are of opinion, that as these are often seen, when there is no wind to waft them over, that after having fix'd the thread on one side, dropping then to the ground, they carry the thread themselves; and mounting where they want to fix it---there draw and fasten it.

PUP. I have often wondered, how snails build their habitations, which they carry about with them.

TUT. Their carrying their own habitations with them, is somewhat singular: I am not surpris'd that your inquisitive eye should have selected out this, as inviting an accurate inspection.

Every animal in nature, has its habitation. The roof under which the snail resides, has two properties, which appear difficult to be united, solidity and lightness. Without which its inhabitant, could neither be protected from injury, nor transfer its habitation from place to place.---At the approach of winter, she retires into some cavity---and her body distills a certain glutinous matter, which closes up the aperture of the shell. Thus shrouded up, she passes the cold season in safety. When the spring season commences, she opens her door---and ranges at her pleasure.

PUP. I think, I remember to have heard something remarkable concerning the eyes of snails.

TUT. Probably you may, for they are uncommonly curious and singular. As they creep upon the
D. 2 ground,

ground, and have the weight of their apartment upon them; if their eyes were not somewhat elevated, they could not well distinguish what they were to avoid, nor what they might approach. To prevent this inconvenience, they are furnish'd with what we may term telescopic eyes. Those which children call the snail's horns, are four tubes, with a glass at the extremity of each; or, if you will, you may call them four optick nerves, which end in as many beautiful eyes. These she can elevate, and turn about in every direction, and lengthen or contract them, as we do the telescope.

PUP. I do not perceive that they have any feet.

TUR. To shew the diversity of the divine works, they have two large muscular skins, which they can lengthen and contract at pleasure, by which means they move and draw their castle, which rests upon their backs. -- And to prevent accidents, they are provided with a viscus humour, which by its cohesion, secures them from falling, and renders them impenetrable to moisture, by an oily matter with which they close all the pores of their skin.

PUP. And now please to inform me how their shell is made?

TUR. The snail has a very small shell, rather soft when she leaves the egg: This shell forms the basis of a second, which is gradually increasing. The first is the centre of the other, and the whole is formed by adding new circles to the first shell. And

as her body can only be extended towards the aperture, this must consequently be the part which receives the fresh accessions. The materials from which the shell is made, are lodged in the body of the animal, and formed by a viscidous fluid, and sandy particles of exquisite fineness, which thicken into a consistence round the extremity of the shell, and become incrustated. This will also give you some idea how the shells of all sorts of fishes are formed.

PUP. I thank you for the trouble you take with me, in giving me these instructions, which so much enlarge my ideas of the wisdom, power and goodness of the Creator.

DIALOGUE XI.

OF PLANTS, AND THEIR PROPERTIES.

TUT. Our indulgent Creator, who formed this earth, for us to live upon, formed it also to produce what is necessary for our support and pleasure. Such as plants, trees and flowers, in very great variety. From the beginning of the world, these have continued in regular succession, without any new creation in any one production of the earth, unto the present day. Neither in living creatures is there any new
D 3 creation.

§4 THE CATECHISM OF NATURE.

creation. Men, beasts, birds, fishes, insects, none of them are lost.---And what merits your particular notice, is, that so many thousands of plants, growing in the same soil, and enjoying the same sun, and the same rain, should differ so much in taste and smell from each other. How conspicuous is the divine wisdom and goodness, in providing for us such a rich variety.

PUP. The earth, the air, and the sea, I perceive is full of his goodness. But why are the plants all of a green hue?

TUT. Green is more pleasing and beneficial to the eye, than any other colour whatever.

PUP. From what are the plants produced?

TUT. From seed, produced by the plants, each produces its like, which lie neatly enclosed in husks, for their preservation. And of these there are above twenty thousand different kinds. Seeds shoot their root downward, and the stalk or trunk, upward.

PUP. And how do they grow?

TUT. By the air, rain, warmth and nourishment which they imbibe from the moisture of the ground, in the small fibres of their roots.

PUP. Of what use is the bark, and the leaves of trees?

TUT. The bark to preserve them from external violence---and to nourish them by the rising of the sap.

lap.---The leaves, to catch and receive the dew and rain.

PUP. I think you told me once that there are not two leaves alike, even on one tree.

TUT. True, two things exactly alike, are not to be found in the whole world. So various are the works of God. The uppermost surface of the leaves is smooth or varnished, that the water may not lodge upon them, which would soon make them decay. The undermost is without that varnish, that it may imbibe the dew.

PUP. Of what use are those trees, which bear no fruit?

TUT. Our forests not only afford us a beautiful variegated prospect, and an agreeable shade---but also timber for building---masts for our ships---materials for husbandry---for furniture---and for the various exercises of art---and for fuel.---Of these, the oak, the ash, the fir, the sycamore, the beech, the elder, the walnut, the elm, the willow, the box, the mahogany and the cedar, are the most valuable.

PUP. I was not before so sensible, of the value of trees, in general, those which I valued most, were fruit-trees.

TUT. And even of these, how plentifully has our heavenly Father provided---and in what pleasing variety! Trees, which bear apples, cherries, pears, plumbs, gooseberries, currants, raspberries, apricots, peaches, grapes, pine-apples, oranges, lemons, nuts,
" D 4 mulberries,

mulberries, quinces, &c. Nor must we omit to mention here the humble strawberry.—What an indulgent parent! who hath not only made such rich provision, for our necessities and bare support---but even for our enjoyment and pleasure:—to please our palate, to refresh, to cool and allay our thirst, during the parching heat of summer.—Neither must we here forget the variety of garden plants and herbs, which God hath provided for our table. The spinage, the cabbage, the sprouts, the colliflower, the lettuce, the artichoke and the asparagus.---And the useful roots, the raddish, the onion, the turnip, the carrot and the potatoe---and many others.

PUP. I hope I shall always love and esteem so kind and so gracious a benefactor---and prove my gratitude sincere, by my unceasing attention to conform to his divine will, in every thing.

TUT. This I do assure you would rejoice my heart---and the hearts of your affectionate parents. God grant this may be the happy fruit of these instructions, not only to you, my dear pupil, but to all who may peruse them.

PUP. How is fruit produced?

TUT. In many plants, the fruit proceeds from the same part where you see the blossom has been. But in the small nut, and the chesnut trees—in the Turkish and Indian corn, the fruit comes where the blossom has never been; [otherwise almost all fruits are preceded by blossom. But the fig comes
to

to perfection without a flower. And in melons, cucumbers, and some others, the fruit is seen before the flower.

PUP. How is the fruit preserved?

TUT. By the shell or rind---but it is not the same in all. In melons and cucumbers, this is very thick, in others very thin. Those lying near the ground, would otherwise be destroyed by insects. And grapes could not be easily pressed, if their skin or rind was like that of the melon. The peach and the plumb, are appointed for our refreshment, at the close of the violent heats. Their use being limited to a short period, their clothing is adjusted, accordingly, and a thin skin is sufficient. The apple and the pear, which are designed to be continued through the winter, have a covering of a more compact contexture. For which reason chestnuts and other species of nuts, are preserved in a still more secure manner. The chestnut in its infant state, is secured from the birds, as is the gooseberry by prickles.—And the walnut, which in its immature state---furnishes our tables with such a fine pickle, would probably be destroyed in its infancy, if it was not secured by the bitterness of its rind.

PUP. And where are to be found the seeds of these fruits?

TUT. As they are very precious for the propagating of their respective species, they are placed within the fruit, in a safe repository.

58 THE CATECHISM OF NATURE.

Some in a hard stone—others with glazed walls.—
One of the most curious which I have seen, is the
cossia.

PUP. How can we best judge when fruit is ripe?

TUT. By the colour, and by the fading of the
stalk, or when with a gentle touch, they are easily
loosened from the branch.

DIALOGUE XII.

OF FLOWERS.

Suppose we now walk into the flower garden.—
See, what a beautiful sight! What variegated colours! How pleasing to the eye! How fragrant to the smell! Heavenly Father! Are these the gifts of thy bounty to man! All those plants of the earth (whether productive of fruits or flowers) which appear more provided for our pleasure than for our necessity, are proofs that God is abundantly gracious.

PUP. You encourage me to trust in the divine goodness—May I now ask you what are those properties of flowers, which I ought more particularly to notice?

TUT. Flowers are distinguishable, by their beautiful

tiful colours, their variety, and by their fragrant smell.—Nor are they merely ornamental, but most of them very serviceable.—It may justly fill you with admiration, that from green plants, so many fragrant flowers should spring up—that from a bulb of no very pleasing form, should arise such variegated tulips—or the beautiful ranunculous, from a dirty little claw; this, unless we had seen, we could never have believed.

PUP. Of what sort are their colours?

TUT. Of all sorts. Sky blue, sea green, common green, olive green, purple, yellow, orange, crimson, red, violet, rose colour, mouse colour, ash grey, and silver colour, &c. &c.

PUP. What have you to observe concerning their smell?

TUT. This consists in the fragrance arising from the juices, and from volatile parts, which are continually exhaling out of the small evaporating tubes of the flowers, or from the leaves.

PUP. Which excel most in fragrance?

TUT. Violets, july flowers, woodbines, roses, lillies, auriculas, &c.—The very mention of which almost renews their fragrance. Some wild heath flowers, and field flowers, have also a peculiar flavour.

PUP. You have said that they are not only ornamental, but useful?

TUT. Yes, flowers cheer the drooping, and refresh

60 THE CATECHISM OF NATURE.

fresh the wearied spirits ; they yield us fruits and feed.—And particularly honey, oil and wax, snuff, perfume, paint and medicines.

PUP. But some flowers have a disagreeable smell.

TUT. They may thereby possibly correct or absorb the noxious vapours. They may serve for food, to some animals and insects, or they may have some medicinal virtues.—With all our boasted knowledge, we have not yet discovered all the excellent uses either of herbs or flowers.

PUP. What a kind and indulgent providence !

TUT. And what a strong argument to trust in divine providence, has our blessed Saviour drawn from even that part of nature we are now contemplating.

“ And why take ye thought for raiment ? consider
“ the lilies of the field, how they grow ? they toil
“ not, neither do they spin ; And yet I say unto you,
“ that Solomon, in all his glory, was not arrayed
“ like one of these. Wherefore if God so clothes
“ the grass of the field, which to-day is, and to-mor-
“ row is cast into the oven, shall he not much more
“ clothe you, O ye of little faith.”

DIALOGUE XIII.

OF SEEDS.

PUP. What means has the All-wise Creator used for the preservation and increase of plants and flowers ?

TUT.

TUT. For this purpose, God has ordained the seed, which however small (and some scarcely visible) yet deserve to be ranked amongst the most skilful works of God.—Each plant produces a great quantity of seed which preserve it to future generations.

PUP. Where are these seeds to be found?

TUT. In some, in the top of the plant, in others, in the middle of it, and again in some between the leaves, or under them. They are found in little husks, or in convenient partitions, separated from each other by a thin skin. Others stand in order together, as in the sun flower.—Does it not appear to you astonishing that such great plants as trees should arise from such small seeds?

PUP. It does indeed---and yet if they were larger they might injure us by the fall. I remember very well the fable of the acorn and the philosopher.—But does one plant, or tree, produce many seeds in one season?

TUT. This is very various.—In some more, in others less. A tobacco plant, has been known to produce more than forty thousand seeds.—An elm tree more than three hundred thousand annually.

PUP. And why such an amazing number?

TUT. Hereby is a great provision made for the fowls of the air. If they were once all consumed, how could we ever recover them again? which might easily be the case, if there was not such a
great

62 THE CATECHISM OF NATURE.

great increase. Admire this display of divine power, wisdom and goodness. For without such a provision, the birds must half of them perish. Food in that form, and small compass, can more easily be preserved for their winter food.

PUP. How do the seeds come out of the pod?

TUT. In dry weather when the pods are wither'd, they open, and the seeds being dry, they easily fall out upon the ground: and those seeds which are not gathered sink into the earth, with the rain.

PUP. What becomes of the lighter seeds?

TUT. They are carried about by the wind---and fall when the wind ceases. For this reason, we see plants upon high old walls and towers; because seeds, falling between the crevices of the stones often grow. Birds also, in carrying them, may frequently let them fall in their flight. And besides this nature has furnished several of them, with soft down, which serve as wings to convey them through the air, to distant places.

PUP. How long will seeds continue?

TUT. Several years, for sometimes wet seasons come on, when seed cannot be gathered in---and then we must have recourse to the old stock.

PUP. What makes the seeds sprout forth?

TUT. Moisture and warmth, which causes a fermentation in the meal, or flower of the seed, and gives the first nourishment of life to the sprout therein enclosed: It no sooner makes its appearance,
than

than it casts off its husk, sends forth a root, and receiving more nutrition it shoots up, and gradually rises to perfection.

PUP. Do seeds, answer any other purpose than those which you have already mentioned?

TUT. Yes, some seeds are food for man, and for beasts, as well as for birds.—They also yield us oil for painting—and provide us, with what is of a medicinal nature.—From which we learn that the smallest things are not to be overlooked, or despised, being often found exceedingly beneficial.

DIALOGUE XIV.

OF THE SEASONS—OF GRASS, CORN, &c.

PUP. What opinion am I to form of the changing seasons?

TUT. That they are so ordained by God, for wise purposes: to promote vegetation, and make men industrious.

PUP. Should not we be better without the winter season?

TUT. By no means, even the winter (the severity of which we feel so sensibly) lays the foundation, for our future sustenance, by making the earth,
more

64 THE CATECHISM OF NATURE.

more productive. And frosty weather contributes to our health.—The earth must have rest too as well as man. So that we ought to be thankful for the winter's cold, as well as the summer's heat. And besides this, when it is winter with us, in the northern part of the globe, it is summer with the inhabitants of the southern hemisphere. And surely we are not so selfish, as to wish to monopolise all the favors of heaven to ourselves.

PUP. But spring, I am delighted with the spring.

TUT. Have you considered why the spring so much delights you?—It is partly owing to the winter you have so lately past through: your having just then emerged out of that rigorous season gives you a more lively perception of the happy change. As a severe fit of sickness gives additional enjoyment to restored health. The spring yields you singular pleasure as a time of promise. What appeared dead before, begins then to assume new life; and presents you with the pleasing hope of the succeeding fruitful seasons. The prospect of the summer, which in process of time, raises every thing to its full maturity. And the prospect of harvest, which not only rewards the toil of the husbandman, and furnisheth us with provision, for the time present; but also sets before us our winter store, that fear of future want may not distress us.

PUP. Which are the most useful products of the earth?

TUT.

TUT. Grass and corn. God causeth grass to grow for the cattle---and bread, which strengtheneth man's heart.

PUP. What is there particularly observable in the grass?

TUT. That it grows spontaneously without the help of man, and affords sufficient food for the beasts of the field. And covers the upper surface of the earth as with a carpet, very pleasing to the eye.

PUP. But what provision is there for the cattle in the winter?

TUT. Part of the grass, is mown and dried, which is then you know called hay. And serves for their winter food. The grass is in some seasons, cut a second time:—or it remains in the field, for the cattles subsistence after harvest, in which state it is in some places called eddish.

PUP. Which are our principal grains?

TUT. Wheat, rye, barley, oats, beans, peas, &c.

PUP. Of what use are the long stalks?

TUT. That the ears may not easily be beat upon the moist ground. They furnish the husbandman, also with straw, for various purposes.

PUP. For what purpose are the stalks so smooth?

TUT. That the rain may easily run off, and not rot them.

PUP. Why have the stalks knots and shoots, or blades?

TUT. That they may not be broken in the open fields.

66 THE CATECHISM OF NATURE.

fields, by the violence of the winds.

PUP. Why are they thus pointed and flexible, or waving?

TUT. The birds would otherwise, sit upon them at their ease, and pick out the grain, and that too before it was ripe.

PUP. For what reason do they sow wheat and rye, before the winter?

TUT. That they may have time for growth. The blade appears time enough before the winter, to stand against the wind and weather--the valuable ear does not then expose itself to the violent season--but waits for warmer weather--and then rises to perfection.

PUP. How do the young plants endure the bleak weather?

TUT. They are richly surrounded with blades, like those of grass, which in the spring of the year fall off in the warm weather--and then the plant feeds and flourishes.

PUP. How is it with the grain?

TUT. The kernels of the grain are securely lodged in strong husks, or chaff, that the sun (after the corn shoots out in the ear) should not scorch and shrivel it, or the rain and dew cause it to rot.

PUP. And what further?

TUT. Also that in time of harvest, the grain may not be shook out and lost, as the husbandman is bringing it into the granary.

PUP.

PUP. How do the ears of corn grow, and how do they ripen?

TUT. When the dew and rain, have made them swell, the enlivening sun dries them by degrees through the whole day. By this means they become fully ripe, and especially when after reaping, the sheaves stand sometime in the field.

PUP. And what is the produce?

TUT. We have never such abundance as to render it of little value. Nor such a scarcity, that men and cattle perish for want of it. A demonstrative proof of a divine providence.

PUP. But suppose there is a failure in the crop?

TUT. When that happens in one place, other countries are generally able to supply the deficiency, which has lately been the case in France; a great scarcity prevailing there, whilst in other nations there was a very plentiful harvest.

PUP. What is the fruitfulness, or product of each stalk?

TUT. The produce is almost incredible, I have been informed, that from one grain of rye, has risen a stalk with seventy-three ears, which yielded in the whole, three hundred and thirty-seven grains.

PUP. Almost incredible indeed! But this I suppose, does not often happen?

TUT. Their different produce depends much upon the nature of the soil—upon good husbandry—the nature of the seed, and the manner of sowing it.

PUP.

PUP. In what other respects, do we see the wisdom and goodness of God in the grain?

TUT. That it can be preserved in granaries, and continue good for some years of bad harvest. Many other fruits of the earth, cannot be preserved one year—and some not one month, and others not one day after they are fully ripe. Neither, is there any herb or plant of the field, which affords us such a wholesome nourishing food. With bread we are never satiated. It is justly called, the staff of life. And yet how insensible are we of its value—how little thankful for bread. O may we never incense the Almighty, by our ingratitude, to teach us the worth of it, by withholding from us the fruits of harvest.

PUP. Of what use is barley?

TUT. Of this malt is made from which we brew ale, beer and also porter, a nourishing strengthening liquor, especially for the labouring part of mankind.

PUP. What use is made of oats?

TUT. In some countries particularly in the northern parts of Great Britain, the common people make a wholesome bread of this grain.—But it is generally given to cattle, particularly to horses, without being ground into meal.

PUP. Which are the most useful plants of those which are not designed for food?

TUT. Flax and hemp. The former, which the Dutch in particular cultivate with great care, is very profitable

profitable to the farmer, and very useful to the world at large.

PUP. In what respect?

TUT. The finest of our linen is made of flax.—It also yields oil.—And when that fine linen is much worn, do you think that it is of any further service?

PUP. I have heard that fine rags are a very acceptable present for hospitals.

TUT. So they are—but would you think that we make our finest writing paper of such rags?

PUP. Make paper of rags! How is that done?

TUT. When ground small, they make of it a pulp, or paste with water and glue, and pour it into flat moulds, from which we receive one of the most useful articles of business. The coarser paper is made of coarser rags.

PUP. That is a curious manufacture indeed, which I should wish to see.

TUT. In our next walk, we will step into the paper mill—and shew you the whole process.

PUP. And what use is made of hemp?

TUT. Of this they make the coarsest of our clothes for sails, sacks, &c. And of this is made our ropes and cables for ships.

PUP. The further you proceed, the more I am amazed at the very ample store of good things, which God hath provided to supply the manifold wants and necessities of mankind.

TUT. The whole world is a storehouse, or grand magazine

70 THE CATECHISM OF NATURE.

magazine, furnished with every article that we have occasion for.

“O Lord how manifold are thy works! The earth
“is full of thy riches.”

CONCLUDING DIALOGUE.

OF THE PRODUCE OF OTHER COUNTRIES, AND
THEIR USE IN MERCHANDISE.

PUP. What advantage have we from the produce
of the other parts of the world?

TUT. As every land has its own particular produce, by means of navigation one country partakes of the produce of another. And thousands gain their livelihood by ploughing the ocean, as the farmers by ploughing the earth.—I will mention to you here some of the principal articles of merchandise, the production of the four quarters of the world, as it may probably be of service to you in future life.---
And if you are not a merchant, it is still proper, as a person of a liberal education, that you should know them.

PUP. You will oblige me.

TUT. From *South America* (by the way of *Spain*)
we receive gold, silver, quicksilver, peruvian bark,
and

and balsam of Peru---Immediately from Surinam, cocoa, cotton and coffee.

From *North America*, tobacco, pipe staves, skins, furs, tar, pitch and rosin.—From the *West Indies*, rice, sugar, coffee, cotton and indigo.—From the *East Indies*, cinnamon, cloves, nutmegs and pepper, tea, china, japan-ware and silks.—From *Africa*, gold-dust, ivory, olives, palm wine, salt-petre, leather, gums and drugs. From the Levant, cotton, raw silk, rhubarb and oil.—From *Spain, Portugal and France*, our best wines,---oranges, lemons, figs, prunes raisins, and chesnuts.—Fine wool is also exported from Spain, and the steel of Biscay and of new Castile, is judg'd to be the best in Europe.—The *Maderia*, and *Canary Islands*, are also well known for their excellent wines, which the hottest weather, so far from impairing, greatly mellows and improves.—From *Great Britain*, wool and iron (manufactured) tin, lead, coals, wheat, barley, malt, oats, ale, porter and cyder.—From *Ireland*, butter, salted meat, and manufactured flax, well known by the name of Irish linen.—From *Norway, Sweden and Denmark*, masts, oak planks, fir timber, stock fish, copper, iron, furs, skins, pitch and tar.—From *Germany*, rhenish wine and hock, forest timber, and wood for fuel.—And the juniper-berry, used in the making of geneva, the best of which is made in Holland.—From *Russia*, hemp, flax, turpentine, pitch, tar, furs, hides and tallow.

72 THE CATECHISM OF NATURE.

PUP. And what is the chief produce of the seven united Provinces, for exports?

TUT. Flax, hemp, madder, butter and cheese, great quantities of which are exported annually. Many thousands also of lean cattle, which are purchased in the north, are fed in these low countries, which afford an almost inexhaustible store for the navy, for merchants ships---and for exportation.

PUP. You have very justly said, that the whole world is a grand store-house for man. How thankful ought we to be, that though there are so many millions of inhabitants on the earth, yet enough is provided for all---and in such abundance too, as totally to banish the distressing apprehension of want.

TUT. Your reflection pleases me, as it shews you have not been inattentive to my instructions.— You also perceive the great benefits of commerce ---by which we obtain the productions of the most remote parts of the globe. So that not only our own country, but the whole earth contributes to the supply of our necessities, convenience, and pleasure. The natives of one country, not only labour for themselves, but for other countries—and others again for them—and by these united efforts, accompanied with a divine never ceasing co-operation, the whole world is supported.

I have now my dear pupil, drawn your attention to the principal parts of nature, as far as your young mind is capable of comprehending them,—I hope
this

this flight sketch, will excite you, with your rising years, to pursue these enquiries, to enlarge your knowledge of the glorious works of Nature, and thereby engage you to love the God of nature,—to serve him—and to magnify his name.

“Ask now the beasts, and they shall teach thee,—and the fowls of the air, and they shall tell thee.—Or speak to the earth, and it shall teach thee.—And the fishes of the sea shall declare unto thee.—Who knoweth not in all these, that the hand of the Lord hath wrought this?”



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